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transducer to the external auditory meatus when it is worn in an auricle, wherein an opening for opening an air chamber formed on the sound emanating side of the electroacoustic transducer by the ear piece is provided in the ear piece and a ventilation resistant material is provided in the opening.

As a result, it is possible to suppress an excess in the low acoustic range and eliminate the resonance in the middle acoustic range thereby ensuring a plain frequency characteristic.

The present invention will be more clearly understood from the following description, given by way of example only, with reference to the accompanying drawings in which:

FIG. 1 is a front view of an earphone according to an embodiment of the present invention;

FIG. 2 is a front view of a state in which the earphone according to the embodiment of the present invention is worn within an ear;

FIG. 3 is an enlarged sectional view of the earphone according to the embodiment of the present invention, taken along the lines III-III' in FIG. 1;

FIG. 4 is a diagram showing a characteristic between a frequency and a response of the earphone;

FIG. 5 is an acoustic equivalent circuit of the earphone of the present invention;

FIG. 6 is an acoustic equivalent circuit for use in explanation of the earphone of the present invention;

FIG. 7 is an acoustic equivalent circuit of a conventional earphone;

FIG. 8 is a front view of the conventional earphone;

FIG. 9 is a front view of a state in which the conventional earphone is worn within the ear;

FIG. 10 is an enlarged sectional view of the conventional earphone, taken along the lines X-X' in FIG. 8; and

FIG. 11 is an enlarged sectional view corresponding to FIG. 10 for use in explanation of the earphone of the present invention.

FIGS. 1 to 3 are an embodiment of an earphone 1 according to the present invention, which has a construction corresponding to FIGS. 8-10. Meanwhile, FIG. 1 corresponds to FIG. 8, FIG. 2 corresponds to FIG. 9, and FIG. 3 corresponds to FIG. 10, respectively. Thus, the same reference numerals are attached to the same components and a description thereof in detail is omitted.

According to the present invention, an opening 34 of a predetermined size is formed through the ear piece 3 and as shown in FIG. 3, for example, a nonwoven fabric 35 is attached as a ventilation resistance to an internal surface of the ear piece 3 so as to close the opening 34.

In this case, the opening 34 is provided at a position opposing the protruding portion 30 with respect to a central portion of the ear piece 3 as a center as shown in

FIG. 1, and when the earphone 1 is worn in the auricle E such that the protruding portion 30 engages the ear hole of the external auditory meatus, the opening 34 is located in the cavum concha F such that it is close to the skin of the cavum concha F.

According to this construction, the air chamber 32 is open to the outside through the opening 34 and the nonwoven fabric 35, and at the same time, a ventilation resistance is presented by the nonwoven fabric 35. Therefore, an acoustic equivalent circuit of the earphone 1 becomes as shown in FIG. 5, in which an acoustic load is presented by a parallel circuit comprising the volume CL by the air chamber 32 and the resistance RL of the nonwoven fabric 35 of the opening 34. Accordingly, level is attenuated in a low acoustic range and a middle acoustic range and at the same time, it is attenuated gradually toward the low acoustic range. Further, a resonance in the middle acoustic range is eliminated by the opening 34.

Referring to FIG. 4, a curve A indicates a result of measurement of a frequency characteristic of the earphone 1 according to the present invention. As evident from the measured result, the low acoustic range is not excessive and its characteristic is extended up to a lower frequency. Additionally, there is no resonance in the middle range so that the characteristic is flat. The same characteristic was obtained by an urethane product as the resistant material and so on in place of the nonwoven fabric 35.

Although in the above embodiment, only one opening 34 is provided as shown in FIG. 1, it is permissible to provide a plurality of the openings so as to obtain a desired characteristic if necessary.

In the above embodiment, the ear piece 3 may be configured by hard plastic material.

Because such an ear phone can obtain a more excellent frequency characteristic, it is possible to ensure a more natural acoustic feeling which conventional earphones can not realize. Further, this can be attained by only providing the ear piece 32 with the opening 34 and the resistant material.

Although the above description is made about the earphone for the left ear, it is needless to say that the earphone for the right ear can be also obtained symmetrically with the aforementioned earphone.

Having described a preferred embodiment of the invention with reference to the accompanying drawings, it is to be understood that the invention is not limited to the above precise embodiment and that various changes and modifications could be effected therein by one skilled in the art without departing from the scope of the invention as defined in the appended claims.

## Claims

1. An earphone comprising:

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an electroacoustic transducer (10) for converting an audio signal to an acoustic sound, and an ear piece (3) which is provided on a sound emanating side of said electroacoustic transducer (10) and for introducing a sound produced by said electroacoustic transducer (10) to the external auditory meatus when the earphone is inserted into a ear, wherein an opening (34) for opening an air chamber (32) formed on the sound emanating side of said electroacoustic transducer (10) by said ear piece (3) is provided in said ear piece (3) and a ventilation resilient material (35) is provided in said opening (34).

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2. An earphone as claimed in claim 1, wherein a protruded portion (30) for engaging with an external auditory meatus is provided on a front face of said ear piece (3) in eccentricity, and a sound emanating hole (31) is provided on a tip end of said protruded portion (30), wherein said opening (34) is provided at a position substantially opposing said protruded portion (30) with respect to a central portion of said ear piece (3) as a center.

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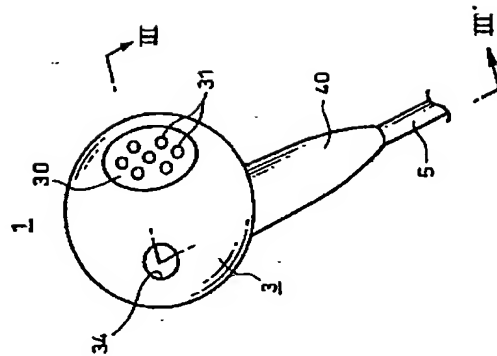
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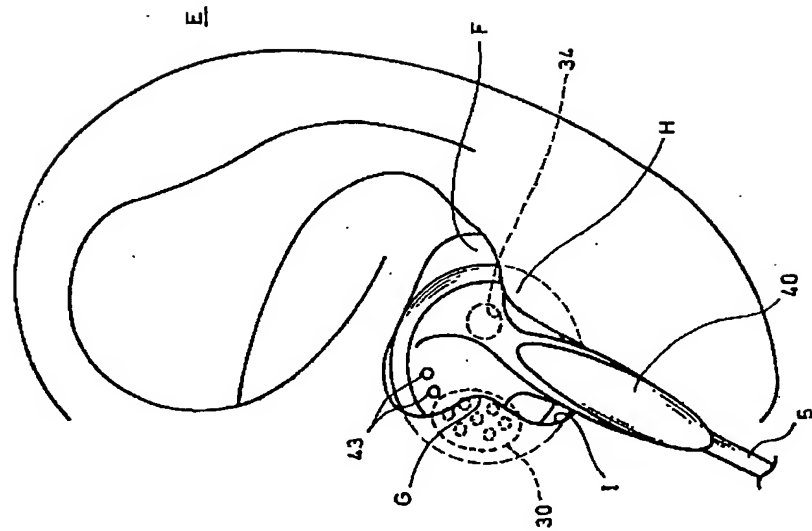
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FIG. 1



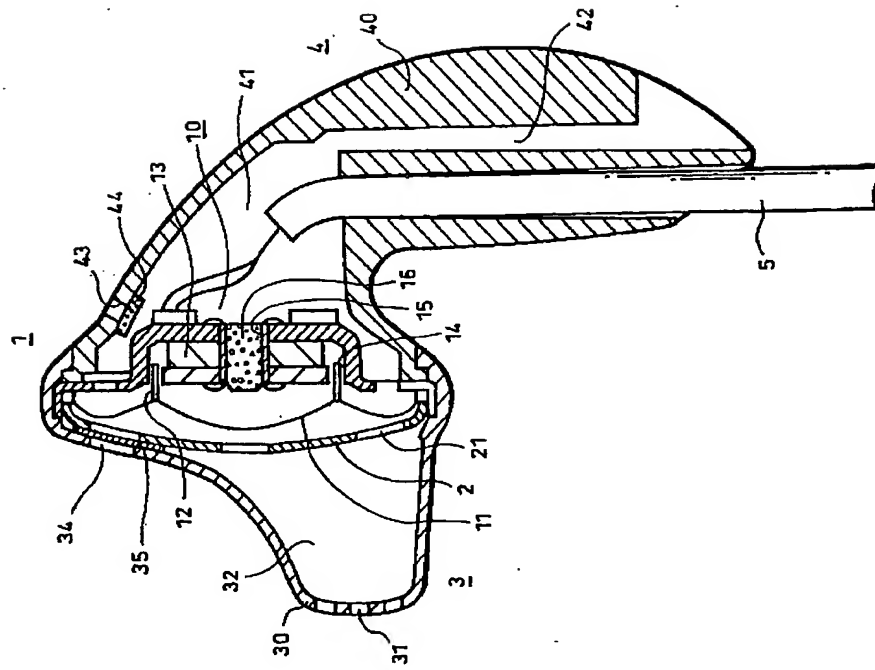
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FIG. 2



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FIG. 3



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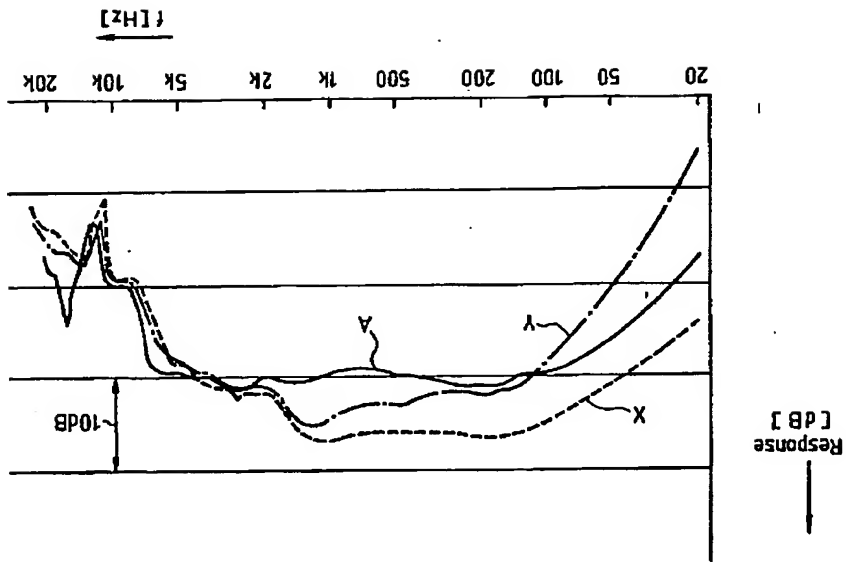


FIG. 4

FIG. 4



FIG. 5

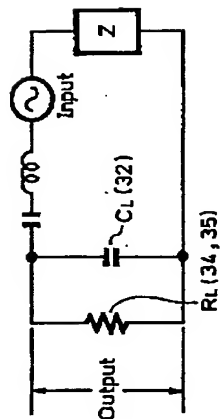


FIG. 6

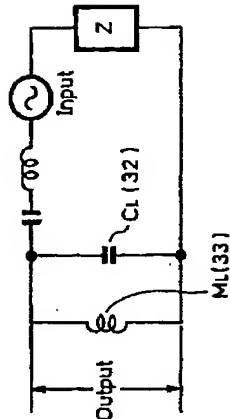
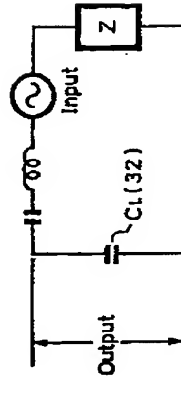


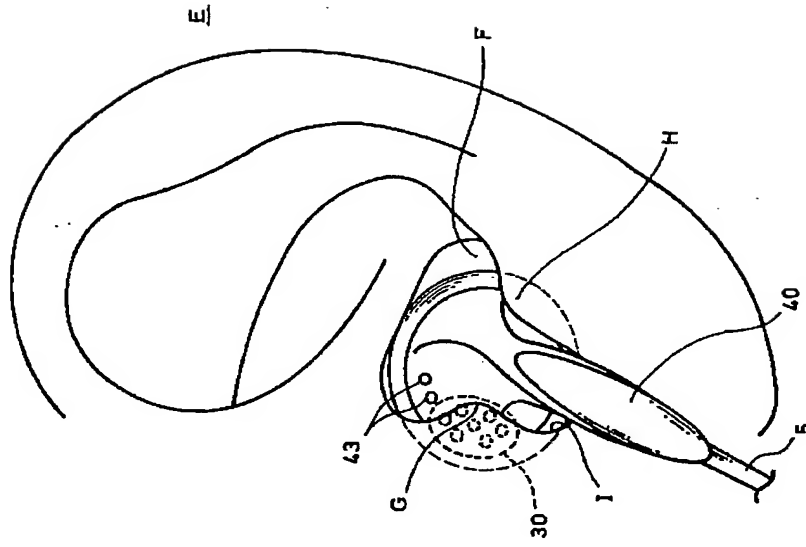
FIG. 7





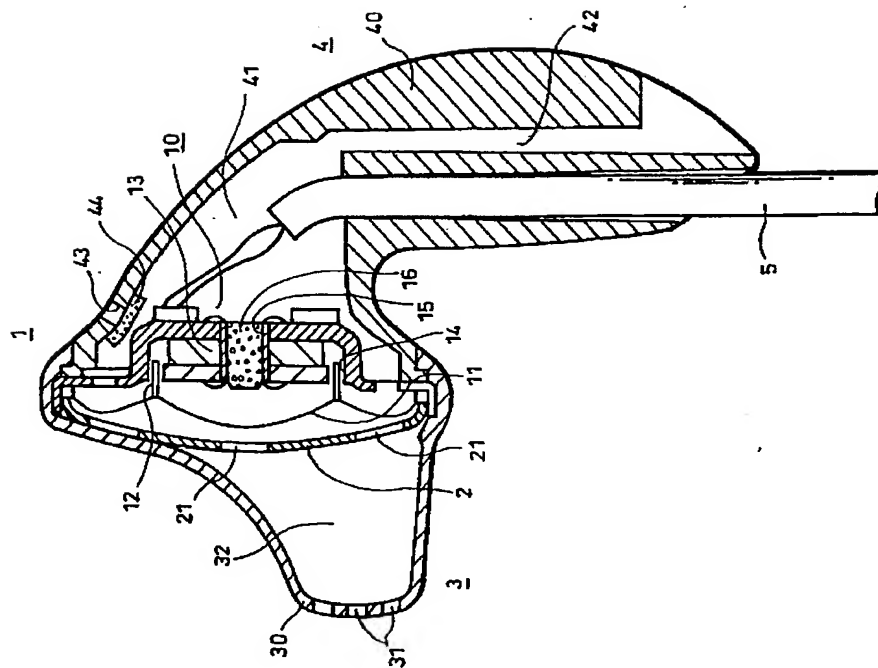
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FIG. 9 (PRIOR ART)



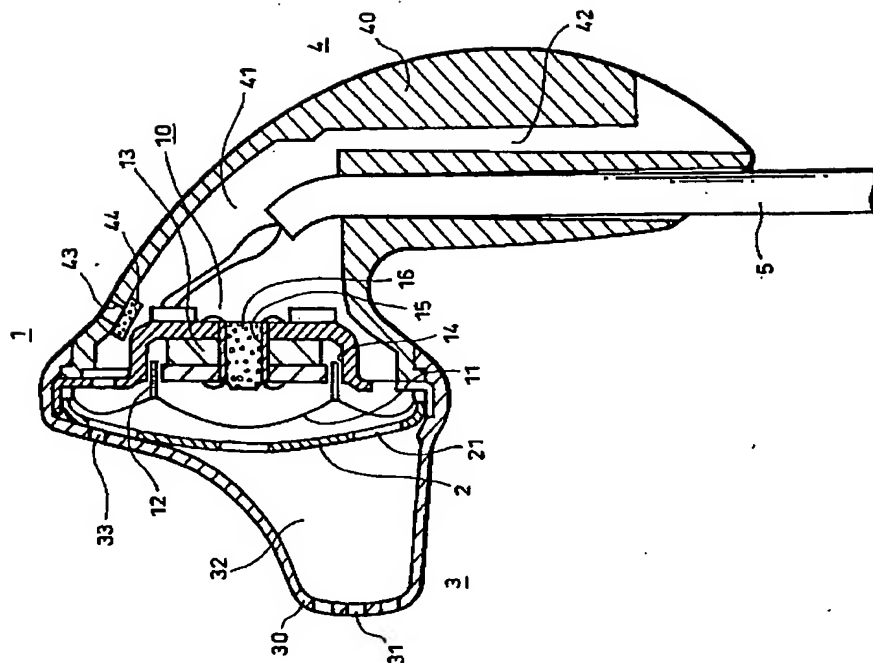
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FIG. 10 (PRIOR ART)



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FIG. 11



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